**3GPP TSG RAN WG1 #100bis-e R1-20xxxxx**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-CLIRIM-01]

Agenda Item: 7.2.11.11

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the following email discussion in AI 7.2.11.11 regarding UE features for CLI/RIM.

[100b-e-NR-UEFeatures-CLIRIM-01] Email discussion/approval on issues with capability signaling impacts for CLI/RIM (20th-24th April) – Hiroki (DCM)

* Confirm to keep FG17-1/2/3/4
* Discuss following on FG17-1
  + Whether the maximum number of measurement resources configured for CLI-RSSI measurement is reported or not
    - Alt.1: UE reports both maximum number of measurement resources configured for CLI-RSSI measurement and maximum number of measurement resources configured for CLI-RSSI measurement within one slot
    - Alt.2: UE reports maximum number of measurement resources configured for CLI-RSSI measurement
    - Alt.3: UE has to support 64 CLI-RSSI measurement resource in order to support CLI-RSSI
  + If the maximum number of measurement resources configured for CLI-RSSI measurement is reported in FG17-1, what are candidate values
  + Whether the component 2 “Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP” is necessary or not
  + Whether FG17-1 is reported per band or per UE
* Discuss followings on FG17-2
  + Whether the maximum number of measurement resources configured for SRS-RSRP measurement is reported or not
    - Alt.1: UE reports both maximum number of measurement resources configured for SRS-RSRP measurement and maximum number of measurement resources configured for SRS-RSRP measurement within one slot
    - Alt.2: UE reports maximum number of measurement resources configured for SRS-RSRP measurement
    - Alt.3: UE has to support 32 SRS-RSRP measurement resource in order to support SRS-RSRP
  + If the maximum number of measurement resources configured for SRS-RSRP measurement is reported in FG17-2, what are candidate values
  + Whether FG17-2 is reported per band or per UE
  + Whether a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot is necessary or not
  + Whether NR supports multi-port SRS-RSRP measurement or not

# **17-1: CLI-RSSI measurement**

In [1], FG17-1 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 17. NR\_CLI\_RIM | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement, The max number of resources across all CCs configured to measure RSSI simultaneously shall not exceed 64  2) Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP. |  |  | N/A |  | [Per UE] | TDD only | Yes |  | UE operates CLI-RSSI measurement. | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [2] | ZTE, Sanechips | Since RAN1 has already agreed that the number of SRS to be monitored by the UE should not exceed 8 within a slot. We do not think it is necessary for the UE to indicate the maximum number of SRS-RSRP measurement resources it supports simultaneously.  Besides, some companies proposed to define a limit across all reference signals for RSRP measurement including SRS, SSB and CSI-RS[1] or reuse any existing UE capability(ies), e.g. *maxNumberSSB-CSI-RS-ResourceOneTx* (defined in TS 38.306). In our opinion, SRS here is used for CLI measurement, so it does not have the same measurement function as other signals, e.g. SSB and CSI-RS. Reusing the existing UE capability(ies) will inevitably affect the measurement requirements and the number of available resources of other signals. So we do not recommend that.  Although CLI-RSSI has no similar agreements on the maximum number of measurement resources within a slot, CLI-RSSI measurement complexity is relatively low and it is also an optional feature. So we do not think that the UE needs to report the maximum number of CLI-RSSI measurement resources, either.  **Proposal 1: It is unnecessary for a UE to report the maximum number of SRS-RSRP and CLI-RSSI measurement resources if it supports feature group 17-1 and 17-2.**  For UE feature type, “Per UE” is preferred only with the limit on TDD bands.  **Proposal 2: For UE feature type, “Per UE” is preferred only with the limit on TDD bands for 17-1 to 17-4.**   |  |  |  | | --- | --- | --- | | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement, The max number of resources across all CCs configured to measure RSSI shall not exceed 64  2) Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP. | |
| [3] | OPPO | Considering various UE capabilities, the maximum number of measurement resources for CLI-RSSI measurement shall be part of UE capability and shall be reported by the UE. Furthermore, the maximum number of measurement resources for CLI-RSSI measurement within one slot shall be UE capability too.  As we agreed, the subcarrier spacing for CLI measurement resource can be same or different from the subcarrier spacing of the active BWP. However, measuring CLI measurement resource with same or different subcarrier spacing would require totally different UE capability. It is preferred to support UE reporting whether support measuring CLI measurement with different subcarrier spacings.  Proposal 1: For FG17-1, CLI-RSSI measurement, support the UE reports the followings:   * maximum number of measurement resources configured for CLI-RSSI measurement.   + The candidate value can be {8, 16, 32, 64} * maximum number of measurement resources configured for CLI-RSSI measurement within one slot   + The candidate value can be {1, 2, 4, 8}  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-1 | CLI-RSSI measurement | * Support CLI-RSSI measurement,  1. The maximum number of resources across all CCs 2. The maximum number of resources within one slot 3. Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP |  |  | N/A |  | Per UE | TDD only | Yes |  | UE operates CLI-RSSI measurement. | Optional with capability signalling | |
| [5] | Ericsson | During the email discussion of the UE features, there were proposals to allow UEs to indicate the maximum supported number of resources across all CCs configured to measure PDSCH CLI-RSSI(17-1) and SRS-RSRP(17-2) simultaneously. This we consider an unnecessary fragmentation of the UE population. Similarly, there were proposals to change the indication from “Per UE” to “Per band”. The motivation for only supporting this function in certain bands are unclear. Hence, we propose:   1. The definitions of 17-1 and 17-2 to are kept as they are with no indication of the number of measurements supported and “Per UE” indication |
| [6] | vivo | Current version does not allow UE to report the max number of CLI-RSSI measurement resource, which means UE has to support 64 RSSI measurement resource in order to support CLI. This will unnecessarily increase the UE implementation burden for supporting the CLI feature. There was similar example in Rel-15 that UE is able to indicate the maximum total number of configured NZP-CSI-RS resources that are supported by the UE for 'CRI/RSRP' reporting across all serving cells, following the same design principle we should also allow UE to indicate the maximum number of CLI-RSSI measurement resource that are supported across all serving cells.   * **In 17-1, to allow UE report maximum number of CLI-RSSI measurement resource that are supported across all serving cells** |
| [7] | Nokia, Nokia Shanghai Bell | * 17-1, component 2 is not necessary:   In RAN1 100e meeting, RAN1 has discussed about the UE operation of CLI-RSSI measurement when the SCS of CLI-RSSI resource is different from the SCS of the active BWP. The conclusion is shown as below, and this has been sent to RAN2/RAN4 [2].  Based on the agreement, UE shall use the SCS of the active BWP while SCS of CLI-RSSI is used as a common reference in the serving cell across different BWPs to indicate a time-frequency resource as a form of the common reference. |
| [8] | Qualcomm Incorporated | On both FGs 17-1 and 17-2,   * Currently the UE can choose to either not support CLI measurement or support CLI measurement but always based on a hard-coded maximum number of 64 CLI RSSI measurement resources or 32 SRS resources. Due to this poor granularity, even if network/UE prefers to enable/perform CLI measurement, the UE may not able to support CLI measurement of such many measurement resources. There seems no obvious benefit to network if a flexible number of measurement resources supported by the UE is not allowed given that a UE may otherwise just totally give up CLI measurement. To avoid this problem, UE should be allowed to report the supported maximum number of measurement resources for SRS-RSRP and CLI-RSSI. The candidate value set can be FFS. * Because this has much more impact to UE PHY implementation than RAN2 signaling, we think this should be discussed in RAN1.   On both FGs 17-1 and 17-2, it is reasonable to allow the UE to report “Per band” support for CLI. For example, for CA case, UE can selectively support CLI measurement on Cells within PCell band but not on Cells inter-band with PCell. The current “Per UE” report has too coarse granularity. We propose to use “Per band”.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement. The max number of resources across all CCs configured to measure CLI-RSSI shall not exceed MB\_1.  ~~2) Up to 64 of measurement resource for CLI-RSSI measurement~~  2) Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP. |  |  | N/A |  | Per band | TDD only | Yes |  | UE operates CLI-RSSI measurement.  1) Component-1, candidate value set for MB\_1 is {0, 8, 16, 32, 64}, with 0 indicating that UE does not support CLI-RSSI measurement.  2) Component-2, UE only supports using active BWP SCS to measure CLI RSSI. | Optional with capability signalling | |
| [9] | Huawei, HiSilicon | The wording in component 2) is not clear enough and probably misleading because it was agreed that configured reference SCS can be different from the SCS of active BWP. Therefore, suggest to replace it with “The configured SCS for the CLI-RSSI resource can be different with that of the active BWP, and the UE performs the CLI-RSSI measurement based on the SCS of the active BWP.” As agreed in R1-2001320.  ***Proposal 1:*** *Replace component 2) in FG 17-1 with “The configured SCS for the CLI-RSSI resource can be different with that of the active BWP, and the UE performs the CLI-RSSI measurement based on the SCS of the active BWP.”*   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-1 | CLI-RSSI measurement | 1) Support CLI-RSSI measurement, The max number of resources across all CCs configured to measure RSSI simultaneously shall not exceed 64  ~~2) Up to 64 of measurement resource for CLI-RSSI measurement~~  2) The configured SCS for the CLI-RSSI resource can be different with that of the active BWP, and the UE performs the CLI-RSSI measurement based on the SCS of the active BWP. |  | [Per UE] | TDD only | Yes | UE operates CLI-RSSI measurement. | Optional with capability signalling | |
| [10] | Intel Corporation | The constraint is for the maximum number of CLI measurement resources configured to a UE. It is not the constraint for the maximum number of CLI measurement resource to be measured simultaneously by a UE. As illustrated in the following figure, if a UE is configured with 64 SRS-RSRP measurement resources but there are only 4 SRS-RSRP measurement resources would be measured simultaneously, then such configuration still violates the agreement made in RAN1 #96, as the total number of SRS-RSRP resources configured exceeds the limit of 32.    Therefore, we propose to rephrase the first component in FG 17-1 and 17-2 as “the maximum number of CLI measurement resources across all CCs shall not exceed” 64 for CLI-RSSI and 32 for SRS-RSRP.   * FG 17-1: Support CLI-RSSI measurement. The maximum number of CLI-RSSI measurement resources configured for a UE across all CCs shall not exceed 64. |

Based on above, following points need to be discussed for FG17-1.

* Confirm to keep FG17-1
* Whether the maximum number of measurement resources configured for CLI-RSSI measurement is reported or not
  + Alt.1: UE reports both maximum number of measurement resources configured for CLI-RSSI measurement and maximum number of measurement resources configured for CLI-RSSI measurement within one slot
  + Alt.2: UE reports maximum number of measurement resources configured for CLI-RSSI measurement
  + Alt.3: UE has to support 64 CLI-RSSI measurement resource in order to support CLI-RSSI
* If the maximum number of measurement resources configured for CLI-RSSI measurement is reported in FG17-1, what are candidate values
* Whether the component 2 “Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP” is necessary or not
* Whether FG17-1 is reported per band or per UE

## 2.1 Discussion 1

**The proposal is to confirm that FG17-1 is kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | c |
| ZTE | We are generally OK with FG17-1. However, it seems that current wording is slightly different with the previous agreements.  **Agreement**  One or multiple resources for CLI-RSSI measurement can be configured   * Maximum number of measurement resource for CLI-RSSI measurement is 64.   The agreements restrict the maximum number of CLI-RSSI measurement that can be configured. The wording that ”Support CLI-RSSI measurement, The max number of resources across all CCs configured to measure RSSI simultaneously shall not exceed 64” actually restrict the maximum number of CLI RSSI resource that UE measures at the same time. Therefore, we suggest to remove “simultaneously ”. |
| Nokia, NSB | Support to confirm. We share similar view as ZTE. |
| Samsung | OK with keeping FG17-1 and also fine with removing “simultaneously”. |
| Intel | Support to keep FG17-1, but the word “simultaneously” should be removed. |
| OPPO | Keep FG17-1 with removing “simultaneously”. |
| Qualcomm | Support to keep FG17-1. Agree to remove “simultaneously”. |
| CATT | Support to keep FG 17-1. |
| Apple | We support to keep FG17-1, and agree to remove “simultaneously”. In addition, we consider the CLI feature is supportive of dynamic TDD, such the prerequisite feature can be 3-6,and/or 5-1a |

## 2.2 Discussion 2

**Companies are encouraged to provide views on whether the maximum number of measurement resources configured for CLI-RSSI measurement is reported or not.**

**Alt.1: UE reports both maximum number of measurement resources configured for CLI-RSSI measurement and maximum number of measurement resources configured for CLI-RSSI measurement within one slot**

**Supported by:**

**Objected by:**

**Alt.2: UE reports maximum number of measurement resources configured for CLI-RSSI measurement**

**Supported by:**

**Objected by:**

**Alt.3: UE has to support 64 CLI-RSSI measurement resource in order to support CLI-RSSI**

**Supported by:**

**Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | ALT3 |
| Nokia, NSB | Alt 3. |
| Samsung | Alt.3 |
| OPPO | 1st preference is Alt1  2nd preference is Alt 2  Not support Alt 3 |
| Qualcomm | We prefer Alt 1 and can also live with Alt 2 if the minimum value of the set candidate values is not defined very big.  We cannot support Alt 3.  Requiring UE to mandatorily measure 64 RSSI resources is a very high requirement for implementation. Given such a high requirement, UE may have to choose to not support CLI. From interference management PoV, this is a bigger loss to system performance than UE measuring < 64 resources.  Rel-16 defines very basic function for CLI (i.e., periodic layer 3 measurement and reporting, etc.). There is really no need to put a high requirement for UE implementation to enable the basic function. It would be more meaningful to have higher UE requirement when more advanced CLI measurement is discussed for example for dynamic TDD in the future. |
| CATT | Alt.3 |
| Apple | We prefer Alt 1, Alt 2 is ok as well. |

## 2.3 Discussion 3

**Companies are encouraged to provide views on candidate values for the maximum number of measurement resources configured for CLI-RSSI measurement (if it is reported for FG17-1).**

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | 1. maximum number of measurement resources configured for CLI-RSSI measurement.  * The candidate value can be {8, 16, 32, 64}  1. maximum number of measurement resources configured for CLI-RSSI measurement within one slot  * The candidate value can be {1, 2, 4, 8} |
| Qualcomm | We support OPPO proposal   * maximum number of measurement resources configured for CLI-RSSI measurement.   + The candidate value can be {8, 16, 32, 64} * maximum number of measurement resources configured for CLI-RSSI measurement within one slot   + The candidate value can be {1, 2, 4, 8} |
| Apple | We support OPPO and Qualcomm’s proposal. |
|  |  |

## 2.4 Discussion 4

**Companies are encouraged to provide views on whether the component 2 “Subcarrier spacing for CLI-RSSI measurement is same as subcarrier spacing for active BWP” is necessary or not.**

**Keeping the component 2 supported by:**

**Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | Prefer no. It is confusing because it has been captured in 38.331 that the reference SCS can be different from the SCS of active BWP. If companies tend to keep it, please at least clarify it as “The configured SCS for the CLI-RSSI resource can be different with that of the active BWP, and the UE performs the CLI-RSSI measurement based on the SCS of the active BWP.” |
| Nokia, NSB | Not necessary. Based on the agreement (Clarification) in RAN1 #100e, this is already clarified as   * + UE performs CLI-RSSI measurement with the SCS of the active bandwidth part within the configured CLI-RSSI resource in the active BWP regardless of the reference SCS of the measurement resource.   Thus, no UE capability is required. |
| Samsung | No need to capture it as the component of FG17-1. |
| Intel | Not necessary. In RAN1 #100-e meeting, it was agreed that   * UE performs CLI-RSSI measurement with the SCS of the active bandwidth part within the configured CLI-RSSI resource in the active BWP regardless of the reference SCS of the measurement resource.   + CLI-RSSI measurement is applicable for RRC\_CONNECTED intra-frequency only.   And it was captured by the CR on 38.215 |
| OPPO | Support to keep **component 2.** |

|  |  |  |
| --- | --- | --- |
| Qualcomm | We would like to ask for companies’ understanding about the assumption in [R1-2001320](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Inbox/R1-2001320.zip) that “UE performs CLI-RSSI measurement with the SCS of the active bandwidth part within the configured CLI-RSSI resource in the active BWP regardless of the reference SCS of the measurement resource”.  Should we consider this assumption as an agreement?  If so, then component 2 can be removed. Otherwise, component 2 is still needed.   |  | | --- | | In RAN1, it was discussed whether CLI measurement (i.e., CLI-RSSI measurement and SRS-RSRP measurement) is applicable for RRC\_CONNECTED intra-frequency only or not. Also, RAN1 considered that the concepts of inter-frequency and intra-frequency are sourced from RAN4. Therefore, RAN1 would like to ask to RAN4 (CC RAN2) for checking and confirmation on following RAN1 assumptions.   * + UE performs CLI-RSSI measurement with the SCS of the active bandwidth part within the configured CLI-RSSI resource in the active BWP regardless of the reference SCS of the measurement resource.     - CLI-RSSI measurement is applicable for RRC\_CONNECTED intra-frequency only. | |
| CATT | Component 2 can be removed. |
| Apple | We share the view with Qualcomm. |

## Discussion 5

**Companies are encouraged to provide views on whether FG17-1 is reported per band or per UE.**

**Defining as per band supported by:**

**Defining as per UE (with FR1/FR2 differentiation) supported by:**

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Per UE |
| Nokia, NSB | Per UE |
| Samsung | Per UE is preferred. |
| OPPO | Per UE |
| Qualcomm | We prefer per band. Per band support allows UE to selectively support CLI in certain band. For example, only in the band of primary cell. |
| CATT | Per UE |
| Apple | Per UE |

# **17-2: SRS-RSRP measurement**

In [1], FG17-2 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 17. NR\_CLI\_RIM | 17-2 | SRS-RSRP measurement | 1) Support SRS-RSRP measurement, The max number of SRS resources across all CCs configured to measure SRS-RSRP simultaneously shall not exceed 32 |  |  | N/A |  | [Per UE] | TDD only | Yes |  | UE operates SRS-RSRP measurement. | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| [2] | ZTE, Sanechips | Since RAN1 has already agreed that the number of SRS to be monitored by the UE should not exceed 8 within a slot. We do not think it is necessary for the UE to indicate the maximum number of SRS-RSRP measurement resources it supports simultaneously.  Besides, some companies proposed to define a limit across all reference signals for RSRP measurement including SRS, SSB and CSI-RS[1] or reuse any existing UE capability(ies), e.g. *maxNumberSSB-CSI-RS-ResourceOneTx* (defined in TS 38.306). In our opinion, SRS here is used for CLI measurement, so it does not have the same measurement function as other signals, e.g. SSB and CSI-RS. Reusing the existing UE capability(ies) will inevitably affect the measurement requirements and the number of available resources of other signals. So we do not recommend that.  Although CLI-RSSI has no similar agreements on the maximum number of measurement resources within a slot, CLI-RSSI measurement complexity is relatively low and it is also an optional feature. So we do not think that the UE needs to report the maximum number of CLI-RSSI measurement resources, either.  **Proposal 1: It is unnecessary for a UE to report the maximum number of SRS-RSRP and CLI-RSSI measurement resources if it supports feature group 17-1 and 17-2.**  For UE feature type, “Per UE” is preferred only with the limit on TDD bands.  **Proposal 2: For UE feature type, “Per UE” is preferred only with the limit on TDD bands for 17-1 to 17-4.**   |  |  |  | | --- | --- | --- | | 17-2 | SRS-RSRP measurement | 1) Support SRS-RSRP measurement, The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed 32. The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed 8 within a slot. | |
| [3] | OPPO | Similar to the CLI-RSSI measurement resources, the maximum number of SRS resources that can be configured for SRS-RSRP measurement shall be a UE capability and the maximum number of SRS resources that can be configured within one slot for SRS-RSRP measurement shall be a UE capability too.  Proposal 2: For FG17-2, SRS-RSRP measurement, support the UE reports the followings:   * maximum number of SRS resources configured for SRS-RSRP measurement per UE. The candidate value can be {4, 8, 16, 32} * maximum number of SRS resources configured for SRS-RSRP measurement within one slot. The candidate value can be {1, 2, 4, 8}  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-2 | SRS-RSRP measurement | * Support SRS-RSRP measurement   1. The maximum number of SRS resources across all CCs   2. The maximum number of SRS resources within one slot |  |  | N/A |  | Per UE | TDD only | Yes |  | UE operates SRS-RSRP measurement. | Optional with capability signalling | |
| [4] | Samsung | It was proposed to define a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot. The following aspects should be clarified with further discussion. First, in case the capability for CLI SRS-RSRP measurement is combined with the SSB/CSI-RS, there may be impacts on the SSB/CSI-RS measurements based on the existing capability. For example, if the CLI SRS-RSRP measurement is counted in a slot toward *maxNumberSSB-CSI-RS-ResourceOneTx*, beam measurements for the SSB/CSI-RS resources would be impacted compared to Rel-15 Ues.  **Observation 1: There may be impacts on the SSB/CSI-RS measurements based on the existing capability due to the joint limit.**  Second, SSB/CSI-RS measurement based on *maxNumberSSB-CSI-RS-ResourceOneTx* is L1-RSRP measurement. On the other hand, CLI SRS-RSRP measurement is L3-RSRP measurement. In our view, it is weird that both L1-RSRP and L3-RSRP measurements are combined within a UE feature.  **Observation 2: Both L1-RSRP and L3-RSRP measurements should not be combined within a UE feature.**  Third, regarding the number of SRS ports, it was agreed to support single antenna port for SRS-RSRP measurement. But, there is still FFS for a support of 2 and 4 ports.  **Observation 3: Single antenna port for SRS-RSRP measurement was agreed with FFS for a support of 2 and 4 ports.**  **Proposal 1: Based on the observations, further discuss a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot.** |
| [5] | Ericsson | During the email discussion of the UE features, there were proposals to allow Ues to indicate the maximum supported number of resources across all CCs configured to measure PDSCH CLI-RSSI(17-1) and SRS-RSRP(17-2) simultaneously. This we consider an unnecessary fragmentation of the UE population. Similarly, there were proposals to change the indication from “Per UE” to “Per band”. The motivation for only supporting this function in certain bands are unclear. Hence, we propose:   1. The definitions of 17-1 and 17-2 to are kept as they are with no indication of the number of measurements supported and “Per UE” indication |
| [6] | vivo | Similarly, as above, we think there is also a need to allow UE to indicate the maximum number of SRS-RSRP measurement resource that are supported across all serving cells.   * **In 17-2, to allow UE report maximum number of CLI-RSRP measurement resource that are supported across all serving cells.** |
| [8] | Qualcomm Incorporated | On both FGs 17-1 and 17-2,   * Currently the UE can choose to either not support CLI measurement or support CLI measurement but always based on a hard-coded maximum number of 64 CLI RSSI measurement resources or 32 SRS resources. Due to this poor granularity, even if network/UE prefers to enable/perform CLI measurement, the UE may not able to support CLI measurement of such many measurement resources. There seems no obvious benefit to network if a flexible number of measurement resources supported by the UE is not allowed given that a UE may otherwise just totally give up CLI measurement. To avoid this problem, UE should be allowed to report the supported maximum number of measurement resources for SRS-RSRP and CLI-RSSI. The candidate value set can be FFS. * Because this has much more impact to UE PHY implementation than RAN2 signaling, we think this should be discussed in RAN1.   On both FGs 17-1 and 17-2, it is reasonable to allow the UE to report “Per band” support for CLI. For example, for CA case, UE can selectively support CLI measurement on Cells within Pcell band but not on Cells inter-band with Pcell. The current “Per UE” report has too coarse granularity. We propose to use “Per band”.  On FG 17-2, we would like to further clarify that RSRP measurement is a computationally demanding operation to UE. Currently RSRP can be measured based on three resources: SSB, CSI-RS and SRS. They together determine the UE complexity for RSRP measurement. It would be necessary to define a joint limit for all these reference signals per port across CLI SRS, SSB and CSI-RS for RSRP measurement in a slot. Besides, we noticed that in TS 38.331, RAN2 has agreed to configure only single port SRS resrouces for CLI SRS-RSRP measurement.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 17-2 | SRS-RSRP measurement | 1) Support SRS-RSRP measurement. The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed MC\_1.  ~~2) Up to 32 of SRS resources to be monitored by a UE~~  2) The max number of SSB/CSI-RS (1Tx) (sum of aperiodic/periodic/semi-persistent) and CLI SRS-RSRP resource ports across all CCs configured to measure L1-RSRP ‘CRI/RSRP’, ‘SSBRI/RSRP’ and ‘CLI SRS-RSRP’ within a slot shall not exceed MD\_1. |  |  | N/A |  | Per band | TDD only | Yes |  | UE operates SRS-RSRP measurement.  1) Component -1, candidate value set for MC\_1 is {0, 8, 16, 32}, with 0 indicating that UE does not support CLI SRS-RSRP measurement  2) Component-2, candidate value set for MD\_1 is {0, 8, 16, 32, 64} | Optional with capability signalling | |
| [10] | Intel Corporation | The constraint is for the maximum number of CLI measurement resources configured to a UE. It is not the constraint for the maximum number of CLI measurement resource to be measured simultaneously by a UE. As illustrated in the following figure, if a UE is configured with 64 SRS-RSRP measurement resources but there are only 4 SRS-RSRP measurement resources would be measured simultaneously, then such configuration still violates the agreement made in RAN1 #96, as the total number of SRS-RSRP resources configured exceeds the limit of 32.    Therefore, we propose to rephrase the first component in FG 17-1 and 17-2 as “the maximum number of CLI measurement resources across all CCs shall not exceed” 64 for CLI-RSSI and 32 for SRS-RSRP.   * FG 17-2: Support SRS-RSRP measurement. The maximum number of SRS-RSRP measurement resources monitored by a UE across all CCs shall not exceed 32.   In R1-1903835 [3], the value range of *nrofSRS-Ports* in *SRS-RSRP-Measurement-ResourceConfig* is listed as “1, [2], [4]”.  In TS 38.331 version 16.0.0 [4], section 6.3.2, the field description for *nrofSRS-Ports* in RRC IE *SRS-Resource* states: “For CLI SRS-RSRP measurement, the network always configures this parameter to ‘port1’.”  Therefore, only single-port SRS can be configured for SRS-RSRP measurement in NR R-16. RAN1 should decide whether to support two-port or four-port SRS-RSRP measurement. If RAN1 decided to support multi-port SRS-RSRP measurement, then the constraint that only single-port SRS can be configured for SRS-RSRP measurement should be removed in TS 38.331.  **Proposal 2:** Discuss and decide whether NR supports multi-port SRS-RSRP measurement. A LS to RAN2 would be needed to inform RAN1’s final decision. |

Based on above, following points need to be discussed for FG17-2.

* Confirm to keep FG17-2
* Whether the maximum number of measurement resources configured for SRS-RSRP measurement is reported or not
  + Alt.1: UE reports both maximum number of measurement resources configured for SRS-RSRP measurement and maximum number of measurement resources configured for SRS-RSRP measurement within one slot
  + Alt.2: UE reports maximum number of measurement resources configured for SRS-RSRP measurement
  + Alt.3: UE has to support 32 SRS-RSRP measurement resource in order to support SRS-RSRP
* If the maximum number of measurement resources configured for SRS-RSRP measurement is reported in FG17-2, what are candidate values
* Whether FG17-2 is reported per band or per UE
* Whether a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot is necessary or not
* Whether NR supports multi-port SRS-RSRP measurement or not

## 3.1 Discussion 6

**The proposal is to confirm that FG17-2 is kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | Support. Its corresponding UE capability has been captured in 38.306-g00. |
| ZTE | Same with Discussion 1, “simultaneously ” in 17-2 can be removed. In addition, “ The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed 8 within a slot.” Can be added to reflect the previous agreements. |
| Nokia, NSB | Support. |
| Samsung | OK with keeping FG17-2 and also ZTE’s suggestion. |
| Intel | Support to keep FG17-2, but the word “simultaneously” should be removed. |
| OPPO | Keep FG17-2 with removing “simultaneouly” |
| Qualcomm | Support to keep FG17-2, and agree that “simultaneously” is not needed. |
| CATT | Support to keep FG17-2. |
| Apple | We support to keep FG17-2, and agree to remove “simultaneously”. In addition, we consider the CLI feature is supportive of dynamic TDD, such the prerequisite feature can be 3-6,and/or 5-1a |

## 3.2 Discussion 7

**Companies are encouraged to provide views on whether the maximum number of measurement resources configured for SRS-RSRP measurement is reported or not.**

**Alt.1: UE reports both maximum number of measurement resources configured for SRS-RSRP measurement and maximum number of measurement resources configured for SRS-RSRP measurement within one slot**

**Supported by:**

**Objected by:**

**Alt.2: UE reports maximum number of measurement resources configured for SRS-RSRP measurement**

**Supported by:**

**Objected by:**

**Alt.3: UE has to support 32 SRS-RSRP measurement resource in order to support SRS-RSRP**

**Supported by:**

**Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | ALT3 |
| Nokia, NSB | Alt3 |
| Samsung | Alt.3 |
| OPPO | Support Alt1. Alt2 is ok too  Not support Alt3. |
| Qualcomm | We support Alt 1.  Compared to RSSI measurement, RSRP computation is a much more expensive operation. Therefore, we will need a limit for the maximum number of SRS resources per slot to avoid too many resources being configured in one slot.  Please also refer to our comments to Section 2.2 Discussion 2 for the corresponding question for RSSI. |
| CATT | Alt.3 |
| Apple | We prefer Alt 1, Alt 2 is ok as well. |

## 3.3 Discussion 8

**Companies are encouraged to provide views on candidate values for the maximum number of measurement resources configured for SRS-RSRP measurement (if it is reported for FG17-2).**

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | - maximum number of SRS resources configured for SRS-RSRP measurement per UE. The candidate value can be {4, 8, 16, 32}  - maximum number of SRS resources configured for SRS-RSRP measurement within one slot. The candidate value can be {1, 2, 4, 8} |
| Qualcomm | We support OPPO’s proposal   * maximum number of SRS resources configured for SRS-RSRP measurement per UE. The candidate value can be {4, 8, 16, 32} * maximum number of SRS resources configured for SRS-RSRP measurement within one slot. The candidate value can be {1, 2, 4, 8} |
| Apple | We support OPPO and Qualcomm’s proposal. |
|  |  |

## 3.4 Discussion 9

**Companies are encouraged to provide views on whether FG17-2 is reported per band or per UE.**

**Defining as per band supported by:**

**Defining as per UE (with FR1/FR2 differentiation) supported by:**

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Per UE |
| Nokia, NSB | Per UE |
| Samsung | Per UE is preferred |
| OPPO | Per UE |
| Qualcomm | We prefer per band. Per band support allows UE to selectively support CLI in certain band. For example, only in the band of primary cell. |
| CATT | Per UE |
| Apple | Per UE |

## 3.5 Discussion 10

**Companies are encouraged to provide views on whether a joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot is necessary or not.**

**Defining the joint limit supported by:**

**Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| ZTE | Not necessary. SRS here is used for CLI measurement, it has different measurement function with other signals, e.g. SSB and CSI-RS. A joint limit for CLI SRS, SSB and CSI-RS for RSRP measurement in a slot will inevitably affect the measurement requirements and the number of available resources of other signals. |
| Nokia, NSB | We share a similar view to ZTE. In general, for TDD, SSB slots are not used for UL. Also, it is not clear to combine L1 and L3 measurement into one capability. Also, due to measurement gap for SRS-RSRP measurement, there is no possibility to assign any measurement resource larger than 8 in a slot. |
| Samsung | No support because it may impacts the existing capability for SSB and CSI-RS measurements and also, a joint limit for L1 and L3 measurements is unclear. |
| Intel | Not necessary. |
| Qualcomm | Thanks for comments from companies. As we mentioned early to question 7, RSRP computation is an expensive operation to UE. It would be preferable from UE implementation PoV to define a joint limit for all these reference signals per port across CLI SRS, SSB and CSI-RS for RSRP measurement in a slot. We do not intend to impact existing capability for SSB and CSI-RS RSRP measurement but use this capability to limit the maximum required computational efforts for CLI SRS-RSRP given UE already computes SSB and CSI-RS based RSRP. |
| Apple | We don’t think this is necessary. |

## 3.6 Discussion 11

**Companies are encouraged to provide views on whether NR supports multi-port SRS-RSRP measurement or not.**

**Supporting multi-port SRS-RSRP measurement supported by:**

**Objected by:**

|  |  |
| --- | --- |
| Company | Comment |
| Nokia, NSB | Support multi-port SRS-RSRP measurement.  With the restriction, the possible reuse of SRS transmission for other purpose may be limited. To reduce the SRS overhead of aggressive UE, it is beneficial to allow any SRS configuration to be used for SRS-RSRP measurement. Regardless of RAN4 performance requirement, it is recommended not to introduce any restriction about SRS configuration. |
| Samsung | No. Not sure a clear motivation to support multi-port for SRS RSRP measurement. But open to further discuss it. One question is that if multi-port SRS RSRP is introduced, is the number of SRS ports considered in calculating max. number of SRS resources in FG17-2? |
| OPPO | No. there is not need to support that. |
| Qualcomm | We prefer to not further optimize SRS configuration given RAN2 has agreed that CLI measurement only supports single port SRS resource. The RAN2 agreement is good in the sense that it makes CLI measurement similar to existing RSRP measurement. Besides, network can still configure up to 4 CLI SRS resources if victim UE is interfered by multi-port SRS from aggressor. However, for Rel-16, further optimization of CLI is not really needed, given that only basic CLI function is defined. Further optimization can be left to more advanced CLI design for example for layer 1 dynamically triggered measurement. |

# **Conclusion**

TBD

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001588 Discussion on UE feature for CLI ZTE

[3] R1-2001740 Discussion on UE features for CLI/RIM OPPO

[4] R1-2002158 UE features for CLI/RIM Samsung

[5] R1-2002279 UE features for CLI/RIM Ericsson

[6] R1-2002404 Discussion on Rel-16 CLI UE features vivo

[7] R1-2002488 On UE features for CLI/RIM Nokia, Nokia Shanghai Bell

[8] R1-2002572 Discussion on UE features for CLI Qualcomm Incorporated

[9] R1-2002596 Rel-16 UE features for CLI/RIM Huawei, HiSilicon

[10] R1-2002686 UE features for CLI/RIM Intel Corporation